

TOWARDS SUSTAINABLE CONSTRUCTION: IMPLEMENTING SUSTAINABILITY EDUCATION AT UNIVERSITY LEVEL

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ABSTRACT

There has been a great deal of acceptance of the importance of higher education in achieving the goal of sustainable development. Integrating sustainability in teaching and learning of undergraduate construction courses has been a challenging and pressing issue in higher education for over a decade. However, to date, not much has been done to incorporate sustainability into the curriculum. The purpose of this paper is to discuss the concept of sustainability education and its related international movements in promoting education for sustainable development. A variety of declarations and programmes have enabled the concept of sustainability to be incorporated in the curriculum of higher education. However more initiatives are needed if sustainability education is to develop at tertiary level. This paper also discusses the obstacles preventing the success of sustainability education and a case study is used to demonstrate the approach of sustainability teaching and learning in practice.

KEYWORDS:

Sustainability education, Higher education, Sustainable development

INTRODUCTION

Economic growth and environmental protection have a two-way interaction. The economy and the environment are mutually dependent on each other's existence for survival. Common (1995) states that the linkages between economic activity and the environment are pervasive and complex. The complexity of the relationship is due to the inherent, and difficult to quantify value of the natural environment to the economy and the natural environment supporting the economy. Hill (1997) suggests that the biosphere would seem to have infinite value, since without the biosphere, nothing can

survive. However, the environmental crisis is now of global importance and yet human economic activity is the principal cause of environmental degradation through exploitation and pollution.

Environmental protection is vital for the existence of a healthy economy and higher education will be an important platform for providing the knowledge, training and skills in achieving the goal of sustainable development (de Rebello, 2003; Haigh, 2005). However there is a growing concern that the current higher education is not relevant to the requirements of the modern world (Combes, 2005) as there is a need to address social and economic dimensions of learning. The current curricula are largely related to cognitive understanding and development. Haigh (2005) states that the present education structures are not established to meet the needs of future but only to reinforce the destructive characteristics of the current age.

There is no doubt that tertiary education has the responsibility for preparing the graduates for entry into the government, business and industry sectors and is expected to make a contribution to sustainable human development, peace and security, and quality of living. According to de Rebello (2003) education is a central strategy for sustainable development and is a vital ingredient for building a sustainable future (Thomas and Nicita, 2002; McKeown and Hopkins, 2003). As such, the key issue of sustainable education is how scholars can incorporate sustainability in their programs whilst dealing with other pressures and maintaining professional standards (Bryce *et al.*, 2004).

Sustainability education is particularly an important issue for the construction professional. In the late 1960s and early 1970s people started to worry about the ability of the ecosystems to support ever-increasing economic activities (Azqueta, 1992). Throughout the world, the building industry is responsible for high levels of pollution resulting from the energy consumed during raw materials extraction, processing and transportation. Industrialised building methods, based on the widespread use of high energy materials such as aluminium, cement, concrete and steel, must now comply with new directives for the protection of the environment.

The construction industry and the environment are intrinsically linked and it is inevitable that the industry has found itself at the centre of concerns about environmental impact. According to Levin (1997), buildings are very large contributors to environmental deterioration. Kein *et al.* (1999) describe the building industry as uncaring and profit motivated, and the members as destroyers of the environment rather than its protectors. Indeed, the construction industry has an irreversible impact on the environment across a broad spectrum of its activities during off-site, on-site and operational activities, that alter ecological integrity (Uher, 1999).

Concern is growing about the impact of building activities on human and environmental health (Thomas and Nicita, 2002). It is clear that actions are needed to make the built environment and construction activities more sustainable (Barrett *et al.*, 1999; Holmes and Hudson, 2000; Morel *et al.*, 2001; Scheuer *et al.*, 2003). The construction industry, whilst important for every society, is also responsible for environmental protection. Sustainability education in construction plays an important role in teaching skills, awareness and the value of the environment, to promote sustainable construction and living. Social and ecological sustainability should be incorporated into teaching in every construction course.

The purpose of this paper is to discuss the concept of sustainability education and its related international movements in promoting education for sustainable development. This paper also presents a case study which is used to demonstrate the approach of sustainability teaching and learning in construction courses.

EDUCATION FOR SUSTAINABLE DEVELOPMENT

Higher education has various responsibilities for the well-being of the environment. There has been increasing activity in considering and implementing environmental literacy and sustainability education at the tertiary level. Sustainable development was endorsed in the United Nations General Assembly in 1987. The importance of education in achieving the goals of sustainable development has been recognised since the 1992 Rio de Janeiro conference and education is mentioned in every chapter of Agenda 21 (McKeown and Hopkins, 2003). Higher education has the responsibility for creating a better and self-sustainable world (de Rebello, 2003; Haigh, 2005; Combes, 2005) and has become a leader in the movement to prevent global ecological

degradation (Moore, 2005a). Since 1990s there have been ongoing discussions about the need for green curriculum at tertiary level to enhance students' knowledge and understanding about the environment (Thomas and Nicita, 2002; Dale and Newman, 2005). Moore (2005a) further states that social and ecological sustainability should be incorporated into teaching and operations at the university level for every subject in every course.

According to Thomas (2004) the concepts of education for sustainability have been acknowledged for over a decade. However there is no agreement on the definition of education for sustainable development (ESD) and it is often used as corresponding to sustainability education (SE), environmental education (EE), education for sustainability (EfS) or green curriculum (Jucker, 2002; Haigh, 2005). McKeown and Hopkins (2003) state that the term EE emerged in the late 1960s and early 1970s in the Belgrade Charter¹ but it is interchangeable with the term ESD and EfS at the international level and within United Nations documents (McKeown and Hopkins, 2003).

Fien (2002) defines education for sustainable development as: to promote explanation and understanding of the meaning of sustainability in curriculum development. Thomas and Nicita (2002) state that education for sustainable development has evolved from the concepts of the green curriculum and environmental literacy. It refers to the understanding and incorporation of environmental issues in teaching and learning in higher education. Indeed sustainability education encourages the integration of understanding the inter-dependence and fragility of the natural and social systems in the curriculum. It encourages students into an active engagement with sustainability issues in order to promote lifestyles that are compatible with the sustainable and equitable use of resources. Bryce *et al* (2005) advocate that the principles of sustainability education should be built into the education system in order to influence future leaders and to expand the principal values of society.

¹ The Belgrade Charter is found in the Final Report of the International Workshop on Environmental Education held in Yugoslavia in 1975 (McKeown and Hopkins, 2003).

Sustainability education must achieve several targets (de Rebello 2003; Combes 2005):

- It must be able to develop an awareness of the concept of sustainability.
- It must have a clear system with clear learning objectives.
- It will enable learners to understand the importance of integrating among disciplines and the nature of interdisciplinarity in sustainability education.
- It must enable people to develop skills and knowledge on both the global and local nature of the issues in sustainable development
- It must inspire learners with the ability and will to integrate sustainable living practices.

Education for sustainable development is a challenge and an opportunity for higher education to become the leader of the world movement in achieving the goal of sustainable development. The public awareness created by education and training will generate an understanding of the linkages among the issues of sustainable development and develop the knowledge, skills, perception and values which will empower people to assume responsibility for creating and enjoying a sustainable future, a core achievement of sustainability education.

INTERNATIONAL MOVEMENTS IN SUSTAINABILITY EDUCATION

There have been many international activities in implementing environmental literacy and sustainability education at the tertiary level since 1985 including the United Nations' campaign for sustainable education (Calder, 2005). In response to the United Nations campaign the Tallories Declaration of University Leaders for a Sustainable Future, October 1990 was signed by over 250 institutions from 43 countries across five continents. It was the first official statement that recognised the importance of including environmental literacy and commitment to university education. (Leal Filho, 2000; de Rebello, 2003; Thomas and Nicita, 2002).

The Halifax Action Plan for Universities of the Conference on 'Creating a Common Future', December 1991 that emerged from the 'Conference on university action for sustainable development' urged universities to place far more weight on the value of interdisciplinary work in sustainability education (Leal Filho, 2000; Haigh, 2005).

The Kyoto Declaration of the International Association of Universities, November 1993 emphasized that the universities around the world have to help solve the problems of global society. This declaration provided several important milestones in the commitment of higher education institutions to marching towards sustainable development (de Rebello, 2003).

Following the Kyoto Declaration the International Conference on Environment and Society, Thessaloniki, Greece in 1997 reiterated the importance of appropriate education and public awareness as a way to sustainability. It also emphasised that the re-orientation of education as a whole is critical for society to move towards sustainability. Other international conferences on higher education and sustainability include the World Conference on Higher Education in 1998, Global Higher Education for Sustainability Partnership in 2001, and the Ubuntu Declaration on Education and Science and Technology for Sustainability Development in 2002. These conferences have stimulated a significant contribution of higher education to sustainable development and improvement of society as a whole (de Rebello, 2003; Calder, 2005).

The Dakar Framework of Action, April 2000 emerged from the World Education Forum in Dakar, Senegal. This framework urges nations to provide both stronger leadership and resources (Haigh, 2005). The Dakar Framework was an important movement to promote “Education for all” which emphasises sustainable education in the less developed countries.

There have been important United Nations programmes promoting sustainability education such as the Earth Summit in Rio de Janeiro in 1992 and the World Summit on Sustainable Development in Johannesburg in 2002. Education has become the main focus of achieving sustainable development on the international agenda (Jucker, 2002; Calder, 2005; Combes, 2005). The 57th Session of the UN General Assembly in December 2002 proclaimed a 10-year period beginning on January, 2005 as the United Nations Decade of Education for Sustainable Development (UNDESD). The United Nations Educational, Scientific and Cultural Organisation (UNESCO) was designated lead agency for the promotion of the UNDESD (de Rebello, 2003; Calder, 2005; Haigh, 2005).

With the declaration of 10-year program, UNESCO was called upon to develop an International Implementation Scheme (IIS) to guide countries, regions, and institutions in fulfilling the promise of the UNDESD. The IIS has drawn on the various international educational initiatives already in process in order to strengthen the relationship between education and sustainable education, such as the Dakar Framework for Action, 2000, and UN Literacy Decade,

UNESCO is also responsible for setting up recommendations to governments on how to promote and improve the integration of education by strengthening teaching, learning and training for sustainable development. The main functions of the UNDESD have four domains (Combes, 2005; de Rebello, 2003; McKeown and Hopkin, 2003):

- Greater access to basic education in order to promote and improve quality education which relates to reviewing and updating of teaching and learning materials to reflect the basic understanding of sustainability.
- Reorienting of education in developing strategies to teach awareness, skills, perspectives and values that will promote sustainable living and sustainability to be part of the curricula.
- Development of public understanding and awareness of sustainability issues to develop sustainability plans, enact sustainable measures and contribute to attaining sustainability goals.
- Providing specialised training programs to bring about the changes required to achieve sustainability for environmental management position.

UNDESD is an international programme directed toward sustainable education and it is structured so as to not only raise public awareness of sustainability education, but also to stimulate action plans that provide both an opportunity and a challenge to all people working in education for a global imperative. With the world becoming increasingly knowledge-based, higher education learning and research are integral to the environmental, social and cultural and economic sustainable development (de Rebello, 2003).

The programme provides an opportunity to progress more quickly in the efforts to make sustainable development a focus of education around the world. As Calder (2005) states, the overall goal of the UNDESD is to integrate the values inherent in sustainable development into all aspects of learning to encourage changes in behaviour that allow for a more sustainable and just society for all. However, the high demand for support from institutions and universities both locally and internationally have hindered the progress of the programme due to the limited funding available.

BARRIER TO SUSTAINABILITY EDUCATION

There are indications that universities in Australia are adopting the concepts of sustainable development in management, teaching and learning at tertiary level. A survey undertaken by Thomas and Nicita (2002) reveals that sustainability education is an area of interest but only a few institutions have embraced the concepts in curriculum development or are working toward it. Other research carried out by Moore (2005a) also reveals similar outcomes. The research was carried out through the interviews of 30 key people in education to find out how university curricula could be more sustainable. From the research Moore (2005b) states that the biggest problem for sustainability education is finding ways to implement it. Budgeting, increasing student numbers and reduced government support are the major hurdles for implementing sustainability education.

Clearly, the arguments for introducing sustainability education are strong and valid, yet only a small number of institutions have accepted the need for curriculum change (Thomas, 2004). There are hurdles and barriers to overcome before sustainability education can be fully implemented. Although the value of sustainability is widely acknowledge within the university community, there are still barriers to sustainability education. Leal Filho (2000) states that the major barrier to achieving sustainability in education is the misconceptions about the issue. Jucker (2002) advocates that sustainability education is difficult to achieve because people are thoroughly unfamiliar with the meaning of sustainability. Thomas (2004) further states that pressure faced by academics in higher education also hinder the implementation of sustainability education. The concept of sustainability is too broad, lacks scientific basis and is too distant from reality while others experience structural and financial

constraints to development of cross-disciplinary initiatives. Leal Filho (2000), Jucker (2002) and Thomas (2004) summarised the barriers as:

- lack of information;
- lack of support both financially and administratively;
- lack of interest and commitment to green initiatives;
- lack of expertise and lack of tradition;
- a long period before the benefits of the efforts of change are seen;
- a general lack of incentives and information on environmental issues.

Thomas (2004) states that an understanding of organisational culture and academic staff development will be important if these barriers are to be overcome. Leal Filho (2000) suggests that financial incentives, rewards and motivation may be used as tools to foster engagement with sustainability. Sustainability should not be left for one discipline or one institute to consider and implement. Instead sustainability should be a movement toward transdisciplinary and transformative ways of knowing and being at the university (Dale and Newman, 2005; Moore 2005a; 2005b). Further research is needed, focused on implementing sustainability education with clear and precise strategies and work plans to encompass sustainability. The overall goal would be to make university research more accessible and to provide a setting for academic and community researchers to integrate and implement sustainability in their communities.

COMMITMENTS TO SUSTAINABILITY EDUCATION AT UTS

In response to the world movement of sustainability education in 1998 the University of Technology Sydney (UTS) signed the Tallories Declaration which signifies that the university recognises a commitment to sustainability in the curricula, teaching practices, research and consulting, community service activities and institutional practices which lead to sustainability in all aspects of human endeavour (UTS, 1999). In 2001 UTS hosted the Inaugural National Conference of Sustainable Campuses with 70 delegates from 28 universities and two TAFE colleges. The conference was dedicated to “sustainable campuses” in relation to energy, solid waste, water management and building design. That conference in 2001 was followed by the

National Conference of Sustainable Universities in Melbourne in 2002, and others in Canberra (2003) and in Cairns (2005).

The UTS policies on sustainability have laid down the foundation for achieving the goal of sustainable development in curricula, teaching and research on campuses. However there are no clear guidelines or strategic policy developed so far on how to achieve the stated targets on sustainability. The followings are achievements that UTS has made since the Tallories Declaration in 1998:

- Research and consulting – there were a number of well established research centres and institutes working on sustainability related programs such as ground water management, biodiversity, science and engineering, including the Institute for Sustainable Future, and the Shopfront.
- Curricula and teaching practices – more academic teaching about sustainability related issues such as earth science, ecology and resource economics are taught in courses in Science, Business, Engineering Design, Architecture and Building, Humanities and Social Science, Law and Education.
- Green Campus Management Group –focused on waste, energy and compliance, integrating sustainability into building design guidelines (e.g. the refurbishment of the Fairfax building).

Despite UTS having signed the Tallories Declaration in 1998 changes to the current curricula have not been adequate. More discussions among academics to determine how sustainability education can be integrated into the curricula of the disciplines and to achieve full engagement of sustainability concepts and teaching are needed. However sustainable policy at UTS is one of the many policies and priorities of the university.

In line with the commitment of the university towards sustainability education incorporating sustainability into teaching and learning has been the goal for the Construction course at UTS. However there are obstacles to implementing environmental literacy and sustainability education. The challenges for incorporating sustainability issues in the curriculum in the Construction course are many. The

present policy and structure do not permit a substantial change to the curriculum and because many lecturers have no or little understanding of sustainability and its incorporation into teaching and learning. In addition there are insufficient textbooks and examples that are available to support sustainability education in construction. As such incorporating sustainability into traditional construction education will become a time-consuming and unrewarding activity for most academics.

On the other hand the School of Construction Property and Project Management, where the Construction course resides, is under the great pressure to improve research output under the proposed Research Quality Framework (RQF). Education is often regarded as a secondary function for the faculty. Under the RQF requirements academics are being forced to place far greater value on research. The School has traditionally been the best performer in terms of research output in the Faculty but under the RQF requirement all academic staff must keep an eye on the advancement of research.; as a result greening the curriculum is not an easy task.

SUSTAINABILITY TEACHING AND LEARNING – A CASE STUDY

Despite the Construction course at UTS having experienced some difficulties in implementing sustainability education a subject has been developed to address sustainability issues. In response to the need of sustainability education and the commitment of the university to the goal of sustainable development, in 2004 the Construction course at UTS developed and offered a subject called Sustainable Building Technology. The subject aims to provide the skills and knowledge to evaluate energy consumption of buildings, alternative technologies and building materials as a means of enhancing sustainability in the built environment. It includes an understanding of the importance of ecologically sustainable development and the provision of strategic advice on the most effective use of resources over a project's life cycle.

The subject was only offered as an elective to students in the final year throughout the faculty as changes to the core structure of the course will incur substantial paperwork as part of the approval process. The subject comprises lectures, tutorials and class role play for four hours face-to-face teaching each week. Students come from a variety of disciplines which included construction, engineering and architecture. The subject has

proved to be a useful approach to improving awareness of sustainability concepts and technology among final year students. It consists of a series of topics delivered by specialist in the area and the topics include:

- The concept of sustainable development in construction
- Introduction to *Your Home* online
- Indoor environments
- Straw bale construction
- Sustainable concrete construction
- Earth building s
- Sustainable water technology
- Alternative power generation
- Whole building environmental life cycle assessment
- Vegetated roof construction
- Rainwater gutter systems
- Green rating schemes

The assessment of the subject consists of an assignment and a formal examination. For the assignment the students were asked to write a discussion paper on the principles of sustainable design and energy efficiency in building projects. Another part of the assignment was related to the use of the BASIX sustainability tool. Since July 2004, residential projects have been required to complete a BASIX assessment in relation to the proposed construction before an application for development can be lodged with any local council in NSW. The details required include the dimensions of the dwelling (such as the floor and roof areas), number of bedrooms, area of landscaping, water and energy efficient features, details of rainwater tanks, insulation, shading and proposed hot water system. A BASIX certificate is provided only if the proposed design meets with the 40% less water consumption and 25% less greenhouse gas emission requirements.

In this assignment students were asked to complete a critique on the use of the BASIX sustainability tool in relation to improving sustainability in construction. They were required to write an essay to comment on usage, limitations and improvement for the tool to be used in the construction industry. Each student was required to carry out a

case study using BASIX. Each student was given a drawing of a single dwelling domestic development using a traditional construction approach. They had to use the web-based tool to assess the project and prepare a report on the compliance and non-compliance of the project to the BASIX requirements. They also needed to provide details of changes that may need to be made to the original design in order to make the project more sustainable and to meet the BASIX standard.

The concept of using BASIX for the assignment, whilst new, challenged the students to move towards sustainable thinking in the design and construction of a project. This is particularly important as the Construction course at UTS is based on the traditional approach and sustainability in the course is largely ignored (apart from the materials in the first year subject Planning and Design Process). Generally speaking, sustainability issues have not been sufficiently dealt with in the curriculum.

The subject has proved to be successful and welcomed by all the students who enrolled in it. At the end of the semester a survey was prepared to obtain students' opinions on the subject and the results were encouraging. About 80% of students said they enjoyed the subject and 75% considered they had learned more about sustainability issues in construction. They considered that the subject provided them with great varieties of topic areas and the topics were interesting and motivational. They considered the BASIX assignment to be a good way to stimulate students into becoming more aware of issues of sustainability.

The feedback for the subject is encouraging and there is no doubt that the subject content has provided a direction for the incorporation of sustainability in future curriculum design. It is hoped that the subject will be made compulsory for all undergraduate students so that the principles of sustainable development can be explained to more people who may make significant contributions to the protection of the environment.

CONCLUSION

Nowadays the environment is under threat yet people are still living in an unsustainable way. It is difficult to imagine that the societal changes required to create a sustainable future will occur without assistance from higher education. Around the

world, demands on the construction professions are changing. There are increasing expectations that building professionals will go beyond a narrow technical focus and take a positive role in working with their communities to formulate solutions in ways that recognise broad concerns about social, economic and environmental sustainability. These changing expectations are starting to be reflected in changes in construction education changes that are commonly driven, at least partly, by forces external to universities.

In this paper the background and initiatives of sustainability education were discussed taking the viewpoint of international movements and commitments of universities to sustainability education. It is still too early to tell how the UNDES D will play out in different countries and regions of the world. However UNDES D is a world programme which has laid down an important framework for an international co-operation and dedication to education for sustainable development. This paper also discussed a case study of implementing sustainability teaching and learning in an elective in a construction degree course. The results indicate that sustainability teaching and learning is generally well accepted by undergraduate students and can help to arouse general interest in sustainability issues. In the future it is hoped that the concept of sustainability will be incorporated into all aspects and disciplines of construction.

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